REMARKS

Claims 1 through 67 are pending in the application. New Claims 66 and 67 have been added. Support for the new claims may be found throughout the application as filed, including, but not limited to, Claims 2 and 41, as originally filed.

In view of the following remarks, reconsideration and withdrawal of the rejections to the application in the Office Action is respectfully requested.

I. Double Patenting Rejection

In the Office Action, Claims 1, 2, 8, 11, 12, 15-21, 23-27, 29, 32, 34, 38, 39, 48, 49, 52-54, 58, 59, 62 and 63 were rejected under the judicially created doctrine of obviousness-type double patenting as unpatentable over Claims 1-33 of U.S. Patent No. 6,791,104 (hereinafter "the '104 Patent") in view of Peter, et al.

In support of this rejection, the Office Action states:

> Claims 1 - 33 do not disclose that the substrate is an InP substrate. However, Peter et al. discloses an optoelectronic device with an InP substrate. Note the first column of page 1951 of Peter et al. Peter et al. explain that the binary InP substrate is advantageous in that it is commercially used and thus technically advanced, has good thermal conductivity and low electrical resistance. Therefore, it would have been obvious to a person having skill in the art to replace the substrate of the device of claims 1 – 33 with the InP substrate such as taught by Peter, et al. in order to provide a substrate that is technically advanced, has good thermal conductivity and low electrical resistance to thus provide higher reliability.

Applicants respectfully traverse.

In order to establish a prima facie case of obviousness, three criteria must be met: (1) the references must provide some motivation or suggestion to combine reference teachings; (2) there must be a reasonable expectation of success; and (3) the resulting combination must teach or suggest all of the limitations of the rejected claims. (MPEP 2142)

The combination of the '104 Patent and Peter, et al. does not meet any of the three criteria listed above.

Obviousness can only be established by combining the teachings of the prior art to produce the claimed invention where there is some teaching suggestion or motivation to make the *proposed* modification either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art. (MPEP 2143.010)

In the present Office Action, the motivation offered by the Examiner would not lead one of ordinary skill in the art to produce the invention recited in the rejected claims. The text of Peter et al. upon which the Examiner relies in support of his rejection reads as follows:

> Types I and II lasers based on the GaInAsSb/AlGaAsSb/GaSb material system have been demonstrated in the 2.0-2.8-μm-wavelength region at room temperature. However, *growth and processing of the GaSb-based material system is less advanced than that of the GaInAs(P)/InP material system* which is commercially used for optical fiber based telecommunication applications in the 1.3-1.5-μm-wavelength range. Furthermore, *the binary material InP has much better thermal conductivity and lower electrical resistance than the quaternary compound AlGaAsSb*, which is particularly advantageous for room-temperature cw operation. (Emphasis added.)

In the context of the paragraph above, it is clear that the advantages relied upon by the Examiner are advantages of InP substrates over GaSb substrates. The cited text provides no suggestion that an InP substrate is more desirable than a GaAs substrate. At best, Peter, et al. provides motivation to replace a GaSb substrate with an InP substrate. However, Peter, et al. provides no motivation to replace the GaAs of the '104 Patent substrate with the InP substrate of Peter, et al. Therefore, because Peter, et al. does not suggest the combination relied upon by the Examiner, Applicants request that this rejection be withdrawn.

In addition, the combined teachings of the '104 Patent and Peter, et al. do not provide a reasonable expectation that the substitution of the GaAs substrate of the '104 Patent with the InP

substrate of Peter, et al. would successfully provide an optoelectronic device or a semiconductor laser.

Due to the complicated interplay between the substrate and the overlying layers in a multilayered optoelectronic device, one of ordinary skill in the art would not reasonably expect that replacing the GaAs substrate of the device described in the '104 Patent with the InP substrate of Peter et al. would provide a functioning optoelectronic device.

The successful interplay between the various layers in a multilayered optoelectronic device depends, at least in part, on the lattice match between the device layers. For example, a paramount concern in fabricating a functioning optoelectronic device is the lattice match between the substrate and the overlying layers. If there is a significant lattice mismatch between the substrate and the overlying layers, defects form in the structure leading to device failure. This fact is explicitly acknowledged in U.S. Patent No. 6,621,842, issued to Dapkus (hereinafter "Dapkus"), which the Examiner cites as prior art in the pending Office Action. With respect to VCSELs (an optoelectronic device), Dapkus states, "In a VCSEL, the number of defects in its layers is minimized when they are grown on a substrate with the same lattice constant and crystal structure. ... there are a limited number of materials that can be incorporated into VCSEL devices that have the high performance required for lasing." (See col. 2, lines 12-17.)

Another important consideration in the fabrication of an optoelectronic device is its emission wavelength range, which depends on the chemical make up of the active region. For example, the emission wavelength of a laser having a GaInNAs quantum well grown *on an GaAs substrate* may be increased by adjusting the relative amounts of In and N in the quantum well layer. However, the ratio of In to N also effects the strain of the quantum well. (See the '104 Patent at col. 3, lines 50-56.) As strain increases, it becomes necessary to decrease the thickness of the quantum well layer in order to avoid defect formation and device failure. However, this decrease is thickness limits the achievable wavelength range of the device. (See, for example, Dapkus at col. 2, line 67 through col. 3, line 19.) Thus, the substrate of an optoelectronic device has a complex relationship with its active region and the successful fabrication of an optoelectronic device depends on the size, chemical nature and relative concentration of the

atoms in the active region *relative to the particular substrate upon which the device is grown.* In light of this complex relationship, one of ordinary skill in the art would not reasonably expect that the simple replacement of the GaAs substrate taught in the '104 Patent with the InP substrate of Peter et al. would successfully produce an operable optoelectronic device. For this additional reason, Applicants respectfully request that this rejection be withdrawn.

Finally, applicants respectfully submit that even if there was motivation to combine the teachings of the '104 Patent and Peter, et al. and that motivation was based on a reasonable expectation of success, the resulting combination would fail to teach all of the limitations of the rejected claims.

Regarding Claims 27, 54, 59 and 63, the Office Action asserts that the '104 Patent teaches a Type II quantum well structure, wherein the semiconductor containing nitrogen is InAsN. However, the Office Action fails to cite (and applicants were unable to identify), any language in the '104 Patent that teaches or suggests the use of InAsN as an electron quantum well layer in a Type II quantum well structure. Therefore, the proposed combination fails to teach or suggest all of the limitations of Claims 27, 54, 59 and 63 and applicants respectfully request that this rejection be withdrawn.

Regarding Claims 53, 58, and 62, the Office Action asserts that the '104 Patent teaches a Type II quantum well structure wherein the semiconductor containing antimony is InGaAsSb. However, the Office Action fails to cite (and applicants were unable to identify), any language in the '104 Patent that teaches or suggests the use of InGaAsSb as a hole quantum well layer in a Type II quantum well structure. Therefore, the proposed combination fails to teach or suggest all of the limitations of Claims 27, 54, 59 and 63, and applicants respectfully request that this rejection be withdrawn.

II. Rejection of Claims Under 35 U.S.C. § 102(b)

Claims 1, 2, 8, 11-18, 21, 24-29, 32, 34- 46, 48-51, 54, 59 and 63-65 were rejected under 35 U.S.C. § 102(b) as anticipated by Peter, et al. Applicants respectfully traverse.

In order to establish a prima facie case of anticipation, a cited reference must teach each and every limitation of the rejected claims. (MPEP 2131)

Peter et al. does not teach and each and every limitation of the rejected claims. Rejected independent Claims 1 and 39 both recite a multilayer semiconductor structure that includes an active region comprising an electron quantum well layer which comprises a semiconductor containing nitrogen. Rejected independent Claim 16 recites a multilayer semiconductor structure that includes an active region comprising an electron quantum well layer of InAsN or InGaAsN. Rejected independent Claim 27 recites a multilayer semiconductor structure that includes an active region comprising an electron quantum well layer of InAsN. In support of the rejection of each of these independent claims, the Office Action states that Peter, et al. discloses a multi-layer semiconductor structure including an active region comprising an electron quantum well layer which comprises a semiconductor containing nitrogen. More specifically, the Office Action asserts that the semiconductor containing nitrogen is InAsN or InGaAsN. Applicants respectfully submit that the Office Action has mischaracterized the teachings of Peter, et al. Peter, et al. teaches light emitting diodes and laser diodes having a Type II structure comprising electron quantum well layers of GaInAs. Peter, et al. does not teach or suggest a Type II quantum well structure that includes electron quantum well layers comprising InAsN, InGaAsN, or any other nitrogen-containing semiconductor. Therefore, Peter, et al. fails to teach each and every limitation of each independent claim in the pending application. For this reason, applicants respectfully request that this rejection be withdrawn.

Applicants further note that dependent Claims 50 and 51 recite semiconductor lasers having active regions that generate light having a wavelength of greater than approximately 2 μm or of approximately 3 μm, respectively. In contrast, Peter, et al. discloses a laser diode having a cw laser emission of only 1.7 μm. (See, Peter, et al. abstract.) Additionally, figure 3 of Peter, et al., shows the lasing spectrum of the laser diode described therein. As shown in figure 3, the laser diode of Peter, et al. has no laser emission at 2 μm or greater. Therefore, Peter, et al. fails to

teach each and every limitation of dependent Claims 50 and 51. For this additional reason, applicants respectfully request that the rejection of Claims 50 and 51 be withdrawn.

Finally, applicants direct the Examiner's attention to Claims 17 and 42 which recite multilayer semiconductor structures that include an active region comprising an electron quantum well layer in compressive strain and a hole quantum well layer in compressive strain. Peter, et al. does not disclose such a structure. Peter, et al. discloses a semiconductor structure that includes an active region comprising an electron quantum well layer (GaInAs) under compressive strain and a hole quantum well layer (GaAsSb) under *tensile* strain. (See, Peter, et al. p. 1951, col. 2.) Because Peter, et al. fails to teach a semiconductor structure including an active layer wherein the electron quantum well layer and the hole quantum well layer are both in compressive strain, Peter, et al. fails to anticipate Claims 17 and 42. For this additional reason, applicants respectfully request that the rejection of Claims 17 and 42 be withdrawn.

III. Rejection of Claims Under 35 U.S.C. § 103(a)

Claims 1-10 and 54-56 were rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent No. 6,612,842 issued to Dapkus (hereinafter "Dapkus") in view of Peter, et al.

In support of this rejection, the Office Action states:

> Dapkus does not disclose that the substrate is an InP substrate. However, Peter et al. discloses an optoelectronic device with an InP substrate. Note the first column of page 1951 of Peter et al. Peter et al. explain that the binary InP substrate is advantageous in that it is commercially used and thus technically advanced, has good thermal conductivity and low electrical resistance. Therefore, it would have been obvious to a person having skill in the art to replace the substrate of the device of Dapkus with the InP substrate such as taught by Peter, et al. in order to provide a substrate that is technically advanced, has good thermal conductivity and low electrical resistance to thus provide higher reliability.

Applicants respectfully traverse.

As discussed in Section I above, in order to establish a prima facie case of obviousness, three criteria must be met: (1) the references must provide some motivation or suggestion to combine reference teachings; (2) there must be a reasonable expectation of success; and (3) the resulting combination must teach or suggest all of the limitations of the rejected claims. (MPEP 2142)

The combination of Dapkus and Peter, et al. fail to meet each of the three criteria listed above for the same reasons that the combination of the '104 Patent and Peter, et al. fail to meet these criteria. The Examiner is referred to Section I above for a detailed discussion of these reasons. For the sake of simplicity, only the conclusions drawn from the detailed discussions will be repeated here.

Peter et al. may arguably motivate one to replace a GaSb substrate in an optoelectronic device with an InP substrate. However, Peter et al. provides no motivation to replace the GaAs substrate described in Dapkus with the InP substrate described in Peter et al. Therefore, the Examiner has failed to establish a prima facie case of obviousness and applicants respectfully request that this rejection be withdrawn.

In addition, the combined teachings of Dapkus and Peter et al. do not provide a reasonable expectation that the substitution of the GaAs substrate of Dapkus with the InP substrate of Peter et al. would successfully provide an optoelectronic device or a semiconductor laser. As discussed in Section I above, the substrate of an optoelectronic device has a complex relationship with its active region and the successful fabrication of an optoelectronic device depends on the size, chemical nature and relative concentration of the atoms in the active region *relative to the particular substrate upon which the device is grown.* In light of this complex relationship, one of ordinary skill in the art would not reasonably expect that the simple replacement of the GaAs substrate taught Dapkus with the InP substrate of Peter et al. would successfully produce an operable optoelectronic device. For this additional reason, Applicants respectfully request that this rejection be withdrawn.

Applicants further note that Dapkus fails to teach or suggest a semiconductor structure that includes an active region comprising an electron quantum well layer comprised of InAsN or InGaAsN, as recited in dependent Claims 2 and 54. Therefore, the combined teachings of Dapkus and Peter, et al. fail to teach or suggest each and every limitation of these claims. For this additional reason, applicants respectfully request that the rejection of Claims 2 and 54 be withdrawn.

Applicants additionally note that dependent Claim 55 recites a multilayer semiconductor structure that includes an optical confinement layer comprising InP or InGaAsSb. Dependent Claim 56 recites a multilayer semiconductor structure that includes a cladding layer comprising InP or AlGaInAs. Neither Dapkus nor Peter, et al. teach or suggest a multilayer semiconductor structure that includes an optical confinement layer comprising InP or InGaAsP. Dapkus and Peter, et al. also fail to teach or suggest a multilayer semiconductor structure that includes a cladding layer comprising either InP or AlGaInAs. Therefore, the combined teachings of Dapkus and Peter, et al. fail to render obvious the subject matter of Claims 55 and 56. For this additional reason, applicants respectfully request that the rejection of Claims 55 and 56 be withdrawn.

In view of the foregoing remarks, applicants respectfully submit that all of the claims remaining in the application are in condition for allowance and favorable action thereon is respectfully solicited.

Respectfully submitted,

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By _____

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